CHAPTER II

REVIEW OF LITERATURE

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2.0 Introduction

"*Knowledge is like light. Weightless and intangible, it can easily travel the world, enlightening the lives of people everywhere. Yet billions of people still live in the darkness of poverty -unnecessarily*" **World Development Report, 1998/1999.**

In the light of above statement, this chapter is devoted to the review of the prior studies to cover the multifactorial aspects of scientometrics studies. It can be seen that there are various research studies carried out which highlight the importance of knowledge generation, diffusion, dissemination and scientometrics methods and techniques for analysis. These studies enable the researcher to identify the gap in research. It also helps in preventing the duplication of the work already been done in the field. The field of scientific research is ever evolving with time, where other subjects are gaining or losing importance, merging or split into new areas of research, it is scientific field only where new research topics are emerging day by day. As the number of scientific publications is increasing, it becomes difficult to keep a record of the growth of one's own field which is a part of the scientific domain. So, it helpful to highlight the different angles of the problem which are already studied. In order to make the new ground for research, it helps the researcher to identify the different aspects of untouched areas and theoretical framework for this study. Considering the importance of the scientometrics studies, the researcher has patented the review of literature thematically.

2.1 Vocational Education and Training

Ogden, William R. (1990) presented the historical perspectives of vocational education, and showed how VET struggle in the educational community. His paper stressed upon the three core objectives of education i.e. civic, personal, and utilitarian. The paper emphasised the need for general skills, general knowledge, and respect for values.

A joint report prepared by **Dunbar, Muriel** (2015) for World Bank and UKAid painted the international perspectives of vocationalisation of education at secondary level. The report informed that as per UNESCO, about 120 countries are involved in vocational education. The report has laid special attention on the prolific countries like England, Germany, Poland, Scotland, China, Malaysia and Brazil.

The paper by **Benavot, Aaron (1983)** studied the cross-national perspective of secondary vocational education. He pointed at the origins of technical-vocational education in both European and non-European systems. Further, he examined the enrollment patterns in vocational education (1950-1975). He also identified the causal factors of cross-national and temporal variations.

The **European Training Foundation (2013)** conference report prepared for ASEM Education Ministers Conference outline the global and country-by-country, inventory of National Qualifications Frameworks. The report reflects the contemporary trends and developments in the field of qualifications frameworks (QFs) worldwide.

Keating, J. et. al. (2002) reviewed prior researchers to make the comparative study of VET systems. Investigation of nine countries across three geographical regions: Europe, East Asia and the Americas are made in the study. Examine of most variables that are defined as the most influential and characteristics or behaviors are apparent for the success of VET systems.

UNESCO's UNEVOC (1996) changed the perception in general public that TVET is treated as the qualification for the blue collor jobs. The TVET seems to be the basic qualification for gaining employability skill for poor but on the job training, specific skill requirement, industrial collaboration etc. makes it a costly affair. UNESCO's UNEVOC had presented the detailed study in financing vocational education and training in developing countries.

Cedefop (2015) in its monitoring report on VET policies 2010-14, illustrates the progress achieved in VET in member countries during 2011-14 for achieving the objectives, set for education and training of Europe's overall 2020 strategy.

UNESCO-UNEVOC (2006) in its reports presented the countries participating in formal technical and vocational education and training programmes worldwide. It also highlights industry demand of skilled labour and the current gap in the supply.

Rosalie L Tuli (1984) observed that high schools in the United States of America (USA) offer a mixture of vocational and non-vocational courses. Due to this, about 25 percent schools can be referred as comprehensive schools. He had further stressed on the historical perspective, testing and minimum standards and impact of cooperative secondary vocational education in the USA.

Lewis, Theodore (1998) argued that vocational education is related to the common core of general education. He discussed that the distinction may be drawn on the basis that VET is for jobs. He advocated a unitary curriculum in proposing vocational education as general education.

Comyn, Paul in **2009** explored "policy initiatives of reaching implications for the management and delivery of education and training under national qualification frameworks (NQFs), including frameworks specifically for the vocational sector (NVQFs)". This paper summarises current developments in the Asia-Pacific region, especially in Bangladesh and Papua New Guinea.

Tripney, Janice S and Hombrados, Jorge G (2013) in their review article presented the world employment crisis. Their study emphasised the need for technical and vocational education and training (TVET). The paper examined previous studies and evaluation of TVET impact in low and middle-income countries among the youth.

Lavrijsen, Jeroen and Nicaise, Ides (2017) also conducted the similar study to assess employability skills to get the returns on vocational education as required by labour market. They examined whether the results are short-term gains or long-term losses in the labour market careers of vocationally and generally educated in 2012. The results suggest that early labour market benefits of vocational specialisation decreased over time.

Independent advisory group chaired by **Anderson, Roy (2014)** the finding of the study revealed that the students educated in the UK institutions are not well prepared

for the market as expected by the age of 18. The comparison detailed that the developing economies are marching forward to meet the needs in changing market demands. The outcome of the study was the recommendation of setting up of focused education policy on economic and social needs, broader curriculum, and soft skills requirement.

Biavaschi, Costanza, et.al. (**2013**) in their report "Youth Unemployment and Vocational Training**,** focused on the determinants of the labour market of developed and developing countries, with special emphasis on the role of VET policies. The report also highlighted the role of demographic factors, economic growth and labour market institutions in explaining young people's transition into work".

In the literature survey by **Markus**, **Linten.** et.al. (2014) they compiled the bibliography of selected documentation for the unit of the federal institute for vocational education and training (BIBB). The documents reported in the bibliography are generated from literature database for vocational education and training.

Hoeckel, Kathrin (2008) authored a monograph entitled Costs and Benefits in Vocational Education and Training for OECD. The study reflects the *substantive and methodological reasons* of cost-benefit analysis of all OECD countries and further identified the determinants of VET costs and benefits.

Bogetoft, Peter and Wittrup, Jesper (2017) have discussed the methods of benchmarking of VET colleges in their study. Their comparison revealed that it is hard to compare a wide range of courses and student which are from the various sociocultural background.

As the VET is a costly affair **UNESCO-UNEVOC (2016)** under the moderation of Phil Lovder and John Stanwick prepared a report based on the virtual conference to measure the return on investment in TEVT.

2.2 Research Methods

Ahmed, Jashim Uddin (2010) in his paper explained the use of documentary research method (DSM) in social research. This study was aimed at providing the general understating about the DSM as a successful method of research. He argued the acceptability of documentary data and DSM as a research method.

Mogalakwe, Monageng (2009) described that the most of the social science researchers are very common largely based on the survey for data collection. The results of these researchers are dominated by the positivist and empiricist approach. He explained the use of documentary research method as an alternative for data collection in social science research.

2.3 Knowledge and Social Structure

Merton, Robert K. (1973) in the edited work by **Norman W. Storer** explained that like other subjects in science activities also involve social collaboration. The integrity of science and society has led scientists to acknowledge their dependence on social structure.

Merton, Robert K. (1957) expressed his observations about the historians of the future. Some of the sociologists of the 20th century may deal science as one of the social institutions of the time. During the past three centuries in which modern science developed, numerous scientists, have engaged in such acrimonious controversy. Long after the sociology of science became an identifiable field of inquiry.

Merton, Robert K. (1961) considered the particular sense in which scientific discoveries can be said to come about without being dependent upon the undoubted genius of the particular scientists who are properly credited with these discoveries, or when we consider here in passing, what he had considered elsewhere at some length, the sociological import of the frequent clashes over priority of discovery that have marked the history of science

Merton, Robert K. (1968) in his paper "The Matthew Effect in Science: The reward and communication systems of science, considered and developed a conception of ways in which certain psychosocial processes affect the allocation of rewards to scientists for their contributions. An allocation which in turn affects the flow of ideas and findings through the communication networks of science".

Price, Derek J. de Solla (1986) in his book in described the science and its place in society. In this book, he has given accounts of the philosophy and the history of science. He wanted to clarify the usual approaches of treating scientific analyses that may be made out of science.

Crane, Diana (1969) studied the social structure in a group of scientists to test the hypothesis of the invisible college. According to her "if the scientists who have published in the area have more social ties with one another than with scientists who have not published, which can be differentiated by degree of social participation within the area".

Davenport, Thomas H. and Prusak, Lawrence (1998) stated that "there is confusion about what is data, information, and knowledge, how they differ from each other. They concluded that data, information, and knowledge are not interchangeable concepts. They began with a brief comparison of the three terms and the factors involved in transforming data into information and information into knowledge".

Kun Nie, et.al. (2007) explained the phenomenon of Knowledge Management (KM). Their paper provides a holistic and better understanding of KM. They have emphasised that why KM is necessary, how KM takes place, how to support KM, etc.

Ozel, B. (2012) used an empirical research method underlying meta-network analysis to study the diffusion of knowledge. This can be employed for studying the movement of knowledge through collective social interaction focusing on nature, chain and modes of knowledge diffusion while exploring the process of knowledge transfer and combined structure.

Singh, J. (2005) have analysed whether an interpersonal network is helpful to study the widely documented two categories of knowledge diffusion: (1) Geographic localization of knowledge flow and (2) concentration of knowledge flows within firm boundaries. By exploring the direct and indirect ties of a network, among knowledge diffuser in a collaborative manner, it was examined that intra-regional and intra-firm knowledge flow is better (strong) comparative to across regional or firm boundaries. Moreover, these interpersonal networks turn out to be important in finding observed patterns of knowledge diffusion.

Ben-David, D. and Loewy, M.B. (2000) explained the standard neoclassical framework with some modification which transforms it into the indigenous growth model. The knowledge accumulation is determined in parts by the knowledge spillover from abroad affected by commercial policies between countries.

Moser, Paul K. and Nat, Arnold vander (2010) made efforts to study the knowledge emerged under the influence of Plato and Aristotle in ancient Greece. Plato in his view as the "Theaetetus" immortalised knowledge as consists of justified and true belief also called 'the traditional analysis of knowledge. Therefore, human knowledge can also be categorised into various categories like empirical and non-empirical description knowledge and; knowledge by acquaintances. Here, empirical knowledge deal with posteriori, non-empirical is a priori knowledge and knowledge by description describes a propositional kind of knowledge. Whereas, acquainted knowledge is a non-propositional kind of knowledge and deals with how to do something.

2.4 Creation and Diffusion of Knowledge

Chen, Chaomei and Hicks, Diana (2004) described that "knowledge diffusion is the adaptation of knowledge in a broad range of scientific, engineering research and development. Due to the complexity of identifying emerging patterns in a diverse range of possible processes tracing knowledge diffusion is a challenging issue. Their paper described an approach that combines complex network theory, network visualization, and patent citation analysis in order to improve the means for the study of knowledge diffusion. They had analysed patent citations in the field of tissue engineering".

Kumar, Ashok and Shivarama, J. (2017) carried out the study based on the systematic literature review. The study was focused on the identification of significant discoveries of the knowledge diffusion and dissemination process. About 138 documents were reviewed out of which 100 were peer-reviewed articles. The literature search was thematical. The study has identified various knowledge creation, theories, models of diffusion and dissemination, collaborative modes and quantitative aspects of knowledge diffusion.

Rodriguez, V, and Soeparwata, A. (2012) has studied the empirical assessment of the performance of the member states. The study has been conducted on the basis of innovation and science technology of the Association of Southeast Asian Nations. Conclusively the study indicates that the Southeast Asian nation shows different growth and performance patterns and the growth is asymmetrical in nature.

Small, Henry and Griffith, Belver C. (1974) in their paper described a computer-based technique experimented to identify clusters of highly interactive documents in science, representing the scientific specialities which currently exhibit high levels of activity.

Katsnelson, Alla (2016) had reported that more money than ever is being invested in research and development. The nations are now pouring higher amount for securing their future economic growth through scientific innovations. In US and Europe during the period 2003-2013 expenditure on research and development was less as compared to the budget spent on scientific activities. Eastern Europe, Asia and Latin America are the emerging regions.

Sonnenwald, Diane H., et.al. (2001) explained "cost effective development of collaboration technology requires evaluation methods. To address the challenge, they had developed a survey to evaluate collaboration technology based on innovation diffusion theory. The theory proposed five attributes of innovations that influence technology adoption: relative advantage, compatibility, complexity, trialability and observability. They had developed a prototype multi-scale survey".

Kumar, Ashok and Shivarama, J. (2017) studied the knowledge diffusion of the Vocational Education and Training domain. The study explored the periodic growth and development of literature. For analysis, they have used web of science core collection data. The study identified various scientometric indicators like publication pattern, highly cited countries, most productive journals, h-index in the field of VET, highly cited papers, core subject, and average citations per item.

2.5 Librametry

Cunningham, S. J. (1996) tried to understand the annihilation rate of Information System (IS) literature. The study was based on the four years proceedings published in International Conference on information science organized specifically for the research. It was found that the death rate of the literature in the field is relatively high similar to engineering and technology dependent science literature.

Vimala, V. and Reddy, V. Pulla (1997) focused on the annihilation rate of the zoology literature by using citation analysis. This kind of obsolescence study of literature helps the librarians to maintain the required literature and collection. The basis of the study was the citations taken from 128 Ph.D. Thesis in the area of zoology submitted to Sri Venkateswara University, Triupati, India from 1962 to 1994.

2.6 Bibliometrics

Liu, Xuan et. al. (2009) informed that the leading countries which are contributing more in the area of global nanotechnology research and development are China, Russia and India. This paper described the research work, published and patents made by these three countries as reflected in the Thomson Science Citation Index Expanded (SCI) database, trademark office (USPTO) database (1996-2007) and the United States patent. They have used the content map, citation network analysis and bibliographies to determine the productivity, pattern of diffusion of knowledge and dominant research topics among these countries.

Lv, P. H. et.al. (2011) made efforts to understand the development in the trend of research of graphene and global scientific production. Peng Hui applied bibliometric analysis and visualization technology using SCI database, conference proceedings citation index database, and Derwent Innovation Index database provided by

Thomson Reuters during the year 1991 to 2010. This research shows that research over graphene has increased in last two decades and has raised enormously during last 5 years

Stegmann, Johannes and Grohmann, Guenter (2006) studied the published literature on bird flu depending on international and national cooperation and networks of authors and countries. In the study, it has been found that the 90% of the research papers have two or more authors. In the study, it was found that the national extramural co-operation since 1998 is 50% whereas a decline in the national intramural is observed and at present, it is around 20%.

Glanzel, Wolfgang (1996) in his paper disscussed the bibliometric method application for analysis of selected six social science subjects. Using Social Science Citation Index (SSCI) data retrieved for the period 1990-1921.

Calver, Michael, et. al. (2010) during their study explained that the label "International Journal" was used widely, which also requires the quality research assessment. They explored 39 conservation biology journals to understand the international implacability of the journal. A single numeric index (IIJ) is used during the study. The index is based on 10 different variables.

Kademani, B. S., et.al. (2002) have highlighted the research collaboration of Ahmed Hassan Zewail, a chemistry Nobel laureate (1999). They have studied 246 papers published during 1976 to 1994 in collaboration with Zewail. They studied the authorship pattern and found that the P. M. Felker (39), L. R. Khundkar (16) and M Dantus (19) have highly collaborated.

Glanzel, Wolfgang (2012) underlined the application, implication and context of scientometrics networks in terms of core documents. He gave an intuitive solution to the problem of arbitrariness of threshold as a result of the application of Hirsch type indices to networks which are mainly found in local clustering.

Kaur, H. and Gupta, B.M. (2010) examined that there is declined towards the analysis of the publication status, its rank, share and growth, particularly India's research output in the area of dental sciences was among top 20 productive countries. The productivity, applicability and quality of the research done by Indian scientist in the area of dental science was explored.

Yu-Wei, Chang (2012) explored the journal articles and thesis published by the researchers in Taiwan more focused on the content bibliometric analysis for evaluation the traits and trends of scientometrics research. It was observed the collaborative or co-authored work dominate the field. Almost half of the articles were published by the scientists in collaboration. An increasing trend is also observed in the quantity of interdisciplinary articles.

2.7 Informetrics

Hood, W. W. and Wilson, C. S., during their review article in 2001 reported that "the term informetrics was first proposed by the Nacke in 1979 for the domain of information science. Which deals with the measurement of information phenomena and the application of mathematical methods". The informetrics was derived from the German term 'informetrie'.

Wolfram, Dietmar (2000) overviewed two primary domains of study within the discipline of information science; information retrieval (IR) and informetrics. Wolfram explained "informetrics is the quantitative study of information production, storage, retrieval, dissemination, and utilization. This study investigates the existence of empirical regularities, development of mathematical models and theories".

2.8 Scientometric

Hood, W.W. and Wilson, C.S. (2001) explained that since the Vassily V. Nalimov had coined the term 'scientometrics', "this has grown in popularity and is used to describe the study of scientific growth, structure, interrelationships and productivity. According to them, scientometrics has overlapping interests with bibliometrics and informetrics".

Dutta, Bidyarthi (2014) outlined in his paper the twentieth century is the time of development of metric sciences. The performance and impact measurement process are gradually systematised. In this way, newer metric sciences are developing incessantly in different subject domains. The paper explained all the metrics generally associated directly or indirectly with the scope and context of library and information science with some brief historical background.

Mingers, John, and Leydesdorff, Loet (2015) studied the quantitative aspects of the process of science as a communication system. They concluded that during the recent year's, scientometric analysis has come in to play a major role in the measurement and evaluation of research. In support of their view they consider the historical development, data sources, various metrics and techniques scientometrics analysis and mapping, evaluation and policy studies.

Raan, A.F.J. van (2004) underlies the bibliometric analysis to study the progress during early 1970's. The paper measures research performance and the impact of standardisation of indicators, which includes the analysis of perspectives like collaboration, interdisciplinary relation and knowledge users.

Bhardwaj, Raj Kumar (2016) examined the research on Ebola virus through scientometric analysis of publications. He examined 2446 publications on Ebola virus covering 159 journals, published from 84 countries, these publications attracted 69960 citations. The maximum share was in the form of articles and review, 2040 (83.40%). The year 2012 was the highly productive. The 2124 (86.8%) publications were contributed by the ten prolific countries. The USA was the leading country. The average citation per publication was 28.6 cpp. The English language, 2149 (87.9%) documents were having highest share.

Gupta, B. M., et.al. (2011) explored the output of Indian research performed during 1999-2008 in computer science. The study was focused on the growth of research, its output, rank and global publication share, share of international collaborative partner and the research communication pattern in most productive journals by using several parameters.

Boyack, Kevin W., et.al. (2009) examined the growth of scholarly knowledge over the time and existing areas of science today, and how they are interlinked. They applied a computational scientometric method for the study. This paper mainly presents a prototype study aiming at the structure mapping and evolution of the research in the area of chemistry over the period of 30 years.

Arunachalam, S. and Doss, M.J. (2000) used SCI data to analyse the international collaboration in the field of science of 11 Asian countries. They have further classified the papers from collaboration among these countries. This classification is on the basis of categorisation of the subject to characterize each country's total and the scientific literature output in collaboration.

Mane, K.K. and Borner, Katy (2004) paper mainly talk about the implacability of Kleinberg's burst detection algorithm to study the occurrence analysis of co-word and generation of maps by group layout techniques that describe the identification of main research emerging topics and trends.

Jayashree, B. and Arunachalam, Subbiah (2000) in their study had focused on mapping of fish research in India. They have used data indexed in the six databases for the period 1994-1999. They examined the volume of work published in the discipline of fish science and the journals used for publishing and identification of prolific institutions.

Gupta, B.M., et.al. (2011) in their paper studied research output of the Typhoid research for the period 2000-2009 in India. They studied rank, growth and share of global publications, citation impact of international collaborative paper share, country wise contribution, and collaboration pattern measured in highly productive journals.

2.9 Webometrics

Didegah, Fereshteh and Goltajis, Marzieh (2010) examined "the level of linking of university websites conducted in most countries i.e. Australia, Canada, China, Iran, and the UK. The findings of the study demonstrated that relationships exist between the level of linking by university websites and activities in the universities. For example, the level of research and the scientific productivity of the universities".

2.10 Altmetrics

Sud, Pardeep and Thelwall, Mike (2013), in their study have focused on the rising use of the social web by the scholars and its result has led to the creation of altmetrics, which is popularly known as social web metrics for academic publications. This new metrics can be used an alternate evaluative metrics to the traditional i.e. impact factor, h-index.

Kumar, Ashok et. al. in 2016 highlighted the importance of the use of web 2.0 technologies. This constitutes the birth of new indicator known as Altmetrics. Their article described the use of following five indicators i.e. recommended, cited, saved, discussed and viewed, as altmetric parameters. In simple words, altmetrics provides an online measurement of scholarly content derived from the web 2.0 social media platforms.

2.11   Citation Analysis

Liang, Yongxia, et. al. (2008) in their article studied the mapping of science as an expanding dynamical research field by implementing information technology. They have found 747 records of articles and 23487 citations when searched the term "citation analysis" in SCI-expanded and SSCI in WOS during 1947-2006. They have primarily focused on multidimensional scaling, citation analysis, social network, analysis, cluster analysis and getting maps of knowledge in "citation analysis" field.

Mingers, John and Evangelia, A.E.C.G. Lipitakis (2010) emphasised on the knowledge quality, produced by management and business academics. The study revealed that the stress is been given to the impact of research instead of their publication journal. The total number of citations received by a paper is considered as the metric for impact. The data was collected from ISI Web of Science but in the

research, it was found that it covers social sciences poorly. Google Scholar, another source of the citation was also taken into consideration.

Labonte, Kristen B. (2010) in her article analysed that whether the library of New California Nano Systems Institute is satisfying the needs of the inter-disciplinary group comprising of 60 faculty members. The study was based on the uses citation analysis. In the process, the latest three publications, published within the last two years, of each faculty member were analysed. As a conclusion, it was found that the library was subscribing to 98% of the journal where the faculty members published or cited more often.

Amin, M. and Mabe, M. in **(2000)** highlighted the JCR impact factor becoming as a bibliometric indicator to quantify the measure of the quality of a journal, the research work published in it, also information about the researchers who submit the papers.

Mishra, P.N. et.al. (2010) had provided the study of the citation analysis of the research and the publication of the National Metallurgical Laboratory (NML) from 1972 to 2007. They have also examined the research work done by the NML scientists and researchers indexed in Science Citation Index (SCI). This study was done using different scientometric parameters.

Kousha, Kayvan et.al. **(2012)** had studied that academicians frequently used online videos for communication and teaching. However, to which extant they are used in published academic research is unknown. The study highlighted the extent the videos on YouTube are cited in academic publications and is there any major extensive disciplinary difference in this practice. They used publications indexed by Scopus to extract the URL citation of YouTube videos. The study revealed that 1808 Scopus publications cited at least one YouTube video and a steady increase.

2.12 Scientometric Mapping

Ivancheva, Ludmila (2008) explored that the present state of scientometrics in the context of methodological and as a stream of the discipline 'science of science'. The paper discussed the stream of science/study in terms of epistemological sense-its development as a general system. The disciplinary structure and its interrelations,

dynamics of research front etc, the scientific knowledge production process-quantitative traits of the research potential, scientific communication, productivity of research, the growth of scientists and research institutions, collaboration in research, research communication network and its structure, etc.

Sagar, Anil et.al. (2013) in the paper made efforts to study the growth and development of literature on dark energy to execute the quantitative and qualitative analyses by evaluating the multiple features of research output as reflected in the Web of Science database.

Sagar, Anil et.al. (2009) reviewed papers which are of mainly significance as scholarly and have become main secondary sources when it comes to access primary literature. This paper documents review articles in a quantitative manner which are published in science citation index during the year 2000-2005. According to SCI a paper is said to be the review if it has 100 or more synchronous references. The result of the search word India typed in the "address word", with the review in the field document type can be extracted for the indicated publication period. This search results in 2042 records by 5135 individual authors in 640 journals.

Sagar, Anil, et.al. (2010) represented the scientometric analysis of all publication related to Tsunami, as recorded by Scopus database in between the period 1997-2008. During this period 4338 publication received 21107 citations. The parameters included in the study were country wise distribution of publications, the growth of publications, activity-index, authorship pattern, frequently cited publications, distribution of keywords and co-authorship index.

Surulinathi, M., et. al. (2009) attempted to analyse quantitative growth and development of knowledge management research in India. The data as reflected in Scopus was used from 1999-2007. Total 51 papers published were retrieved. It revealed the year-wise growth of publications.

Gomathi, P. (2014) presented the bibliometric study to analyse the SRELS journal of information management. The citation analysis, and content analysis are the commonly used bibliometric methods to analyse academic literature quantitatively. Bibliometric methods are most often used in the field of Library and Information Science. Thus, this paper discusses on authorship pattern, institution wise, subject wise, length of articles, number of keywords used and country wise publications.

Ghouse, M. N., et.al. (2013) attempted to investigate the scholarly communications in College & Research Libraries (CRL) journal during the period of 1997-2011 and to study the key dimensions of its publication trends. Bibliometric parameters are applied to examine the publication data. Results revealed nearly 32 articles have been contributed to each issue of CRL. The highest contribution is from the single author followed by two and three authored articles. The average degree of collaboration is 0.57, apart from this average per author, testing of Lotka's law, citation pattern, identification of prolific journals and authors, countries, have been reported in the study.

Kumari, G. Lalitha (2009) analysed the research output and impact in Synthetic Organic Chemistry (SOC) during 1998–2004. "She had applied standard scientometric indicators. The study intended to determine the Adopting relative indicators (ARI) – Absolute Citation Impact (ACI) and Relative Citation Impact (RCI), a cross national comparison. Based on this analysis, it was concluded that G7 nations have decreasing citation trend. As far as the Asian region is concerned China out-performed India".

Guan, Jiancheng and Ma, Nan (2007) compared China's scientific research in the semiconductor-related field with major Asian nations. The SCI– Expanded database for the period 1995–2004 was explored. Results showed that China is the second productive country in the semiconductor research. The Asia's publication profile reflected that China is more inclined to work in collaboration than other counterparts like Japan and South Korea. The citation-based measures were used to assess the quality of research. It was one of the results that Chinese scientists have low visibility at international level, instead of strong efforts.

Dwivedi, S., et.al. (2015) analysed 17,344 papers authored by Indian scientists in the subject domain of organic chemistry and its sub-areas duly indexed in Web of Science during the period 2004–2013. Academic institutions share 46% of the total output followed by the Council of Scientific and Industrial Research (CSIR) with 26% share. Indian researchers tend to publish papers in international journals having impact factor greater than 1. About 11% of the papers during the study period remained uncited.

2.13 Publication Productivity

Yazit, Norhazwani and Zainab, A.N. (2007) in their study painted a picture of research publications of Malaysian LIS organisations. The objectives of the study were to found the total number of publications, the number of active authors, authorship pattern, etc.

2.14   Indicators

Link, Albert N. (1995) in the paper discusses the appropriateness of literature-based innovation output indicators in the evaluation arena, and it sets forth criteria against which to judge such appropriateness. Many of the traditional evaluation methods are based on analytical frameworks that require at least an informal quantification of such outputs.

Ding, Jingda and Qiu, Junping (2011), as it is difficult to obtain indicator weights in evaluation studies, in this paper Ding and Qiu had discussed a new way for improving the indicator weights of scientific and technological competitiveness by evaluating the work in the universities of China. By making use of representative mathematical methods of least square and the coefficient method, they determined the objective weights of the indicator.

Okubo, Yoshiko (1997) reported bibliometric indicators and analysis of research systems by providing good basic information about on bibliometrics and how it can be applied to research systems for their analysis. The Study explained that how bibliometrics turns out as an essential tool for determining the research activities. His report overall sheds light on the need for the development of the bibliometrics. It also

explains the underlying need for developing bibliometrics as well as the principal indicators used for its development.

Hou, Jianhua, et.al. (2010), aimed to study the identity and notify the hot topics and trends in the field of scientific collaboration through scientometric analysis. To explored the evolution of the scientific collaboration techniques as information visualization and knowledge domain visualization were implanted. They studied 1455 articles from the year 1993 to 2007 retrieved from SSCI, SCI and A&HCI database on the topic of scientific collaboration or scientific co-operation. They also made us of aware citespace software in order to carry out the study further.

Garfield, Eugene (2000) stated "that the impact factor has become the subject of widespread controversy. It has gradually developed to mean both journal and author impact. The emphasis on impact factors obscures the main purpose of bibliographic databases created at the Institute for Scientific Information. He showed two of these databases, Journal Citation Reports and the Journal Performance Indicators, can be used to study scientific journals and the articles they publish, as well as the evolution of scientific fields".

Bergstrom, C.T. et.al. (2008) in their editorial note discussed the misuse of journal impact factor for hiring and promotions. Their article discussed this problems and alternatives for measuring individual's impact.

Lippi, Giuseppe and Mattiuzzi, Camilla (2017), in their study aimed to improve the process of evaluation of scientists; they had developed a new indicator scientist impact factor (SIF) for measuring scientific output. The SIF is further tested by them through analysing the publication and citation data of 40 scientists.

Subramanyam, K. in 1983, described the collaborative endeavour of scientific research. The nature and magnitude of collaboration vary from subject to subject depending on the research problem and other research settings. In prior studies traditional methods to study the collaborations were survey and observation. These methods are not efficient enough to determine collaboration. His paper pointed that several types of collaboration can be studied using bibliometrics tools and methods.

Singh, S. and Pandita, R. (2017) had studied the growth of Indian research journals indexed by SCImago Journal and Country Ranking. In their, study they have taken the period of ten years (2005-2014). The examination revealed key aspects like distribution journals indexed their annual corresponding growth, subject wise distribution and, Indian percentage share. The analysis showed that India stand at the 6th position to have highest share (452) journals indexed by the SCImago. The citation index of the total journals indexed by Scopus, 1.97% is from India. Among Asian countries, about 17 percent journals indexed are of Indian origin.

The purpose of the study carried out by **Navaneethakrishnan, S. (2014)** was the identification of authorship patterns and degree of collaboration among the authors of humanities and social science domain of Sri Lanka during the period (1960 – 2012). For getting the data Scopus database was explored. The bibliometric research method was applied to analyse the data. The study found that major share of publications is highly collaborative contributed by multiple authors. Most of the collaborative contributors are from USA (15.93%).

2.15 Index

Various popular productivity index used by the scientists are discussed as below.

2.15.1 h-Index

Hirsch, J. E. in **(2005)** proposed the h-index to attribute the scientific output of an individual researcher. He defined h-index as the total no. of citation received by a paper is always higher or equal h but never less than it.

Minasny, Budiman, et.al. in **2007** had realized that soil science is one of the emerging new specialised fields of science. So, he made use of h-index as the parameter is determining the scientific output of the research papers published in the field. The author came up with governing factors to calculate h-index in the area of soil science. Which can be enlisted as (1) no. of scientists working in the field, (2) their age (3) the no. of papers they published (4) the no. of average citation. In the study, it was found that the relation between the h-index and science: h=0.7.

Interestingly it was found that the value of h-index is quite smaller for soil science in comparison to other scientific fields.

Lazaridis, Themis (2009) in his paper paid attention to the ranking given to the universities and departments related to H-index. As we all know that university ranking gathered the attention quite lately, however, the ranking of its department gives a clear resolved picture about the quality of work within each university. In this article, the Hirsch (H) index of individual faculties in the department of chemical engineering, physics, chemistry and material science was determined for their ranking. This ranking is actually very relevant and meaningful as it seems to describe the research performance of individual departments.

Jacso, Peter (2009) in his experiment determined the h-index of 10 Ibero American countries of South America. He had compared data as reflected in the Web of Science (Science Citation Index, Social Science Citation Index, and Arts & Humanities Citation Index) and the Scopus database. The findings found that the in spite of the significant differences the rank correlation of the ten countries based on the h-index values returned high value.

Ouimet, Mathieu et.al. (2011) carried out a study focused on answering the following questions: determine the ranking of social scientists having different epistemological faiths and methodological beliefs, is the h-index and few of its modified forms provided any kind of dissemination. The study was done by considering a dependent variable h-index and six of its derivatives show the results of five to the bit and two negative binomial regression models.

Banks, M. G. (2011) in this paper described the books published in 2011 and interesting modification of h-index, which is a more suitable index for topics and compounds. The new hot topics can be differentiated from the older topics by just comparing the nb index and m index. This interesting and fast method is discussed to help the new researchers to know that what quality and quantity of work in already been done in their area of research.

Sangwal, Keshra (2012), suggested the index which is age-independent and underlies the h-type index per decade, is renamed as an index. Also, it can be calculated as the square-root in terms of the ratio of citation acceleration to the Hirsch constant A.

2.15.2 g-Index

Egghe, L. (2006) proposed one of the important index which has an advantage over the other index. One of the best features of this indicator is that in the mechanism a simple single number can be used to describe both publications no. i.e. the quantity of research, as well as the citation score which is related, is the research quality. The main idea to introduce the g-index is to improve the h-index of Hirsch. According to Egghe "if this set is ranked in decreasing order of the number of citations that they received, the g-index is the (unique) largest number such that the top g articles received (together) at least g2 citations".

Tol, Richard S.J. (2008) focused on the department of applied economics in Ireland the g-index was proposed and applied successfully in 2007. This rational index performed better because the successive of g-index has more differed power than the successive h-index. Another feature of successive g-index is that it is more robust and can also discriminate in the size of the departments.

2.15.3 p-Index

Prathap, Gangan (2010, 2012) ranked top 100 prolific economists using a new kind of indicator known as performance index abbreviate as (p-index). This p-index provides a kind of balance among activity total c citations and the excellence that is the citation rate C/P. In the study, the h-index which is actually an index accepted worldwide was found as one of the canonical tools for the assessment of research done by the institution.

Assimakis, N. and Adam, M. (2010) in his paper introduce a new kind of productivity index for authors called Golden productivity index. This index describes the productivity of single author by calculating and exploring the number of papers with the co-authorship rank. Application of this method turns out to be more effective

to determine the opinion of the author towards paper writing in comparison to other methods available.

2.16   Co-authorship, Correlation and collaboration

Ponomariov, Branco and Boardman, Craig (2016) described that in Science and technology co-authorship is used as the proxy for research collaboration because an individual could be in the author's list for various reasons instead of the actual contribution. In this study, a national (USA) sample of academic researchers was asked about their relationships with their closest research collaborators with whom respondents had co-authored. The results showed numerous dimensions of co-authorship, the most influential is informal relational, intellectual and other resources.

Cross, Rob et.al. (2016) reported that the collaboration is taking over the workplace. Their study was based on the data of past two decades to explore the global and cross functional aspects of the business. They revealed the time spent in collaborative activities has ballooned by 50% or more.

Zeng, Xiao Han T. (2016) et. al. emphasised that "the collaboration plays an increasingly important role in promoting research productivity and impact. To study this they reported an empirical analysis of the complete publication records of 3,980 faculty members in six STEM disciplines at select USA research universities".

Daum, Kevin J. (2013) in his article How smart people collaborate for success explained about the importance of collaboration for greater accomplishments, solving complex issues, and to achieve fruitful results.

Thomson, Ann Marie, et.al. **(2007)** conceptualised and measured collaboration. Their paper proposed an empirically validated theory of collaboration measurement. The findings in the study presented developing and testing the construct validity of a multidimensional model of collaboration. Data was collected using email questionnaire sent to the 1382 respondents.

Wolfgang, Glanzel and Thijs, Bart (2012) had highlighted "the notion of 'core documents'. It was first used in the context of co-citation analysis and later re-introduced for bibliographic coupling and extended to hybrid approaches of representation of the core of a set of documents".

Hsu, Jiann-wien and Huang, Ding-wei (2010) have "obtained data of statistical significance to verify the intuitive impression that collaboration leads to higher impact. To analyse the correlations between the number of citations and the number of co-authors, they studied eight scientific journals. The study found that around 70% of the citations were accumulated in 30% of the papers, while 60% of the co-authors appeared in 40% of the papers".

Newman, M. E. J. (2004) has "used data from three bibliographic databases in biology, physics, and mathematics, respectively. Based on this data networks are constructed in which the nodes are scientists. If the two scientists are connected that means that they have coauthored a paper. Newman used these networks to answer a broad variety of questions about collaboration patterns".

Khan, Gohar Feroz, et.al. (2011) in their article propose mapping and visualizing of the core scientific domains using social network analysis (SNA) techniques derived from mathematical graph theory. In particular, "the concept of Network of the Core is introduced which can be employed to visualize scientific domains by constructing a network among theoretical constructs, models, and concepts".

Borgatti, Stephen P. et.al. (2009) discussed "the explosion of networked research across the physical and social sciences. According to the study, the theory of network analysis yields explanations for social phenomena in a wide variety of disciplines from psychology to economics. In this essay, they have reviewed the kinds of things that social scientists have tried to explain using social network analysis and provide a nutshell description of the basic assumptions, goals and explanatory mechanisms prevalent in the field".

Bjorneborn, Lennart and Ingwersen, Peter (2001) reported the emergence of new research fields. Both of them attempted to point out the selected areas of webometric research. They have been focused on the problem of measuring web impact factors (Web-IF) of websites.

Kleinberg, Jon (2004) explained the small-world phenomenon, which means that we are all linked by short chains of acquaintances, or "six degrees of separation". According to Kleinberg "it is a fundamental issue in social networks. The problem has its roots in experiments performed by the social psychologist Stanley Milgram in the 1960s".

Cantner, Uwe and Graf, Holger (2004) have applied "social network analysis methods to describe the evolution of the innovator network of Jena, Germany in the period from 1995 to 2001. They have been found this evolution to focus on core competencies of the local innovation system".

Conclusion

The detailed review of literature presented hare revealed that VET has a strong base in the American and European countries, the force behind this origin industrial revolution and expansion of colonisation in other continents. As VET is a costly affair the UNESCO-UNEVOC is promoting cost effective VET across the world to fight poverty and sustainable development. Further, the knowledge origin and social structure philosophies given by the pioneer authors have been discussed. There are a different kind of methods of knowledge creation and diffusion. Scientometrics is also one of the quantitative methods of research to study the diffusion of knowledge.

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